MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2019 / 2020

PCF 0145 – CELL AND FUNCTION

(Foundation in Life Sciences students only)

18 October 2019
3.00 p.m. – 5.00 p.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **FIVE** pages only excluding the cover page.
2. Answer **ALL FIVE** questions.
3. Please write all your answers in the answer booklet provided.
4. Distribution of marks for each section / question is given.

STRUCTURED QUESTIONS [50 MARKS]

Instruction: Answer **ALL FIVE** questions.

Question 1 [10 marks]

a. In *evolution*, there are known *reproductive barriers* between species which can be classified as either *pre-zygotic* or *post-zygotic*. Based on this, answer the following:

(i) What is the difference between *pre-zygotic* or *post-zygotic reproductive barriers*? (1 mark)

(ii) *Pre-zygotic reproductive barriers* include *temporal isolation*, *habitat isolation*, *mechanical isolation*, *gametic isolation* and *behavioral isolation*. Define *any* TWO of these types of barriers. Identify a specific example for each of the TWO types of barriers that you have defined. (2 marks)

b. The three types of *natural selection* are termed *directional selection*, *disruptive selection* and *stabilizing selection*. Using a population of rabbits with varying shades of fur colour (**Figure 1**) as a specific example, answer the following:

(i) Define these three types of *natural selection*. Provide the main key points for each of these three types of *natural selection* in your answer. (3 × 1 mark)

(ii) In a "patchy" habitat that is partly covered with white snow and partly with exposed black soil (without snow), which of these types of *natural selection* will likely predominate for a population of these rabbits after a period of time? Why is that? (1 mark)

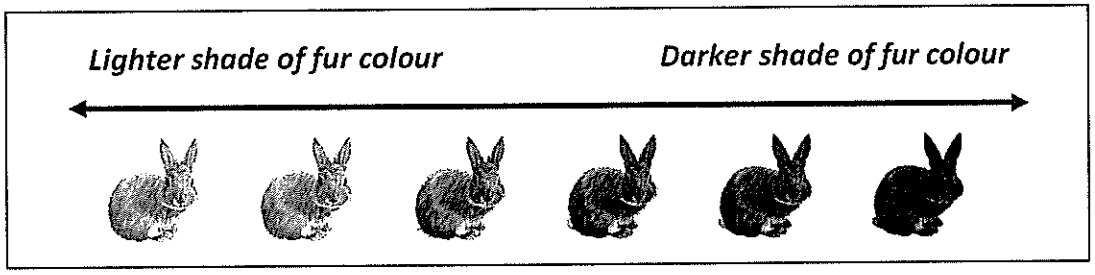

Figure 1

c. The *mark-recapture method* is a useful and widely used method in ecological studies. Based on this, answer the following:

(i) What is the *mark-recapture method*? What is the purpose of using this method? (2 × ½ mark)

(ii) There are THREE *assumptions* that have to be made when a scientist carries out the *mark-recapture method*. Describe these THREE *assumptions*. (3 × ½ mark)

(iii) The *mark-recapture method* is said to be a sampling technique. State a simpler sampling technique besides this *mark-recapture method*. (½ mark)

Continued...

Question 2 [10 marks]

a. **Figure 2** details the processes that take place during the *Calvin cycle* with each process numbered as ❶, ❷, ❸ and ❹. Based on **Figure 2**, answer the following:

(i) Where in the *chloroplast* does the *Calvin cycle* take place? (½ mark)

(ii) Explain what happens during process ❶. (½ mark)

(iii) Explain what happens during process ❹. (½ mark)

(iv) What happens to the G3P molecule which leaves the *Calvin cycle*? (½ mark)

(v) What is *process "X"*? What is its significance? (2 × ½ mark)

(vi) What is the role of ATPs in the *Calvin cycle*? Where do these ATPs come from? (2 × ½ mark)

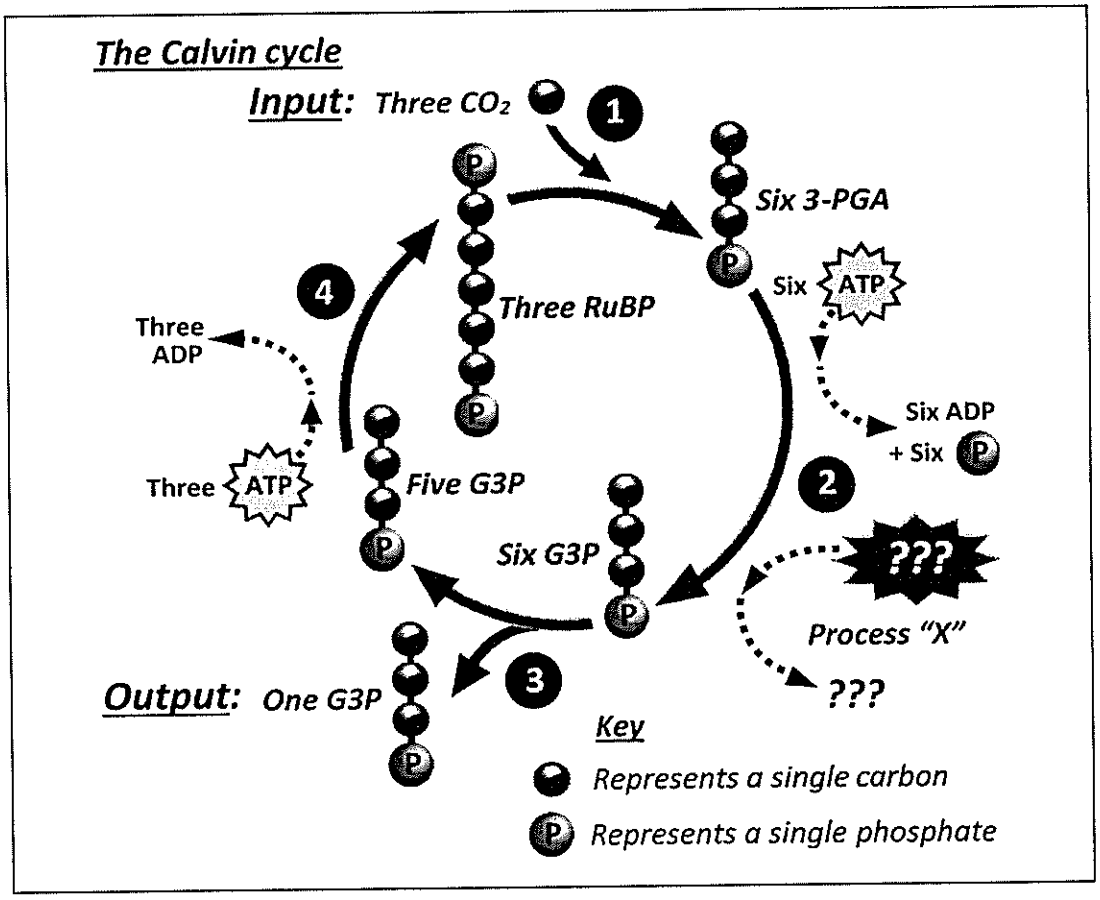

Figure 2

b. Using a well-labeled diagram, sketch the link between *light reactions* and the *Calvin cycle*. Be sure to include the following vital molecules in your diagram: H_2O, O_2, CO_2, $C_6H_{12}O_6$, ATP, ADP + P, NADPH and $NADP^+$. (4 marks)

c. *Blood* plays an important role in the human body and serves several functions. Explain FOUR important functions of *blood*. (4 × ½ mark)

Continued...

Question 3 [10 marks]

a. Gas exchange in human lungs involves three phases, namely *breathing*, *transport of gases* and *exchange of gases*. Based on this, answer the following:

(i) What happens during each of these three phases? Explain briefly. (3 × ½ mark)

(ii) Explain THREE features of the lungs which are *adaptations* for gaseous *exchange*. Explain how each of these features facilitates gaseous *exchange*. (3 × ½ mark)

(iii) What are *stretch receptors* and what are their functions? (2 × ½ mark)

(iv) What is *hemoglobin* and what is its function? (2 × ½ mark)

b. *Carbon dioxide transport* is an important process in breathing as it involves transportation of carbon dioxide from body tissues to the lungs, where carbon dioxide will eventually be exhaled. Based on this, answer the following:

(i) What is the function of the enzyme *carbonic anhydrase*? (½ mark)

(ii) How is carbon dioxide transported from body tissues to the lungs? (2 × ½ mark)

(iii) Once inside a red blood cell, carbon dioxide combines with which molecule to become *bicarbonate*? (½ mark)

(iv) Within a red blood cell, the *carbonic acid* formed from the combination of carbon dioxide and water dissociates into which TWO components? (½ mark)

(v) What is the fate of the *bicarbonate* that results from the *deprotonation* (the removal of *hydrogen ion*, H^+) of *carbonic acid* within a red blood cell? (½ mark)

c. **Figure 3** depicts the processes of *cohesion* and *adhesion*, both of which are vital to the movement of water molecules from the ground to the leaves through the process called *transpiration*. What is the main <u>difference</u> between *cohesion* and *adhesion*? What property of water (H_2O) enables these two processes? (2 × 1 mark)

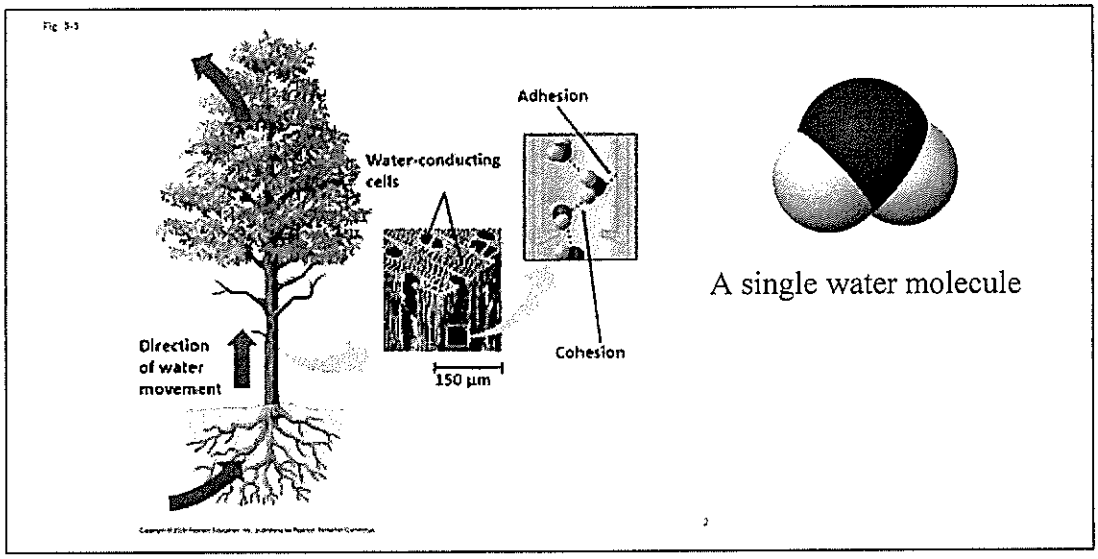

Figure 3

Continued...

Question 4 [10 marks]

a. **Figure 4** depicts a cross-section view of the *human heart* with a list of 9 heart structures. With this diagram as a reference and guide, answer the following:

(i) Starting at the *superior* and *inferior venae cavae*, list the order (sequentially) in which a drop of blood passes through the 9 heart structures listed in **Figure 4**. (4 × ½ mark)

(ii) What is the function of the *bicuspid valve* and *tricuspid valve*? (½ mark)

(iii) What is the difference between *pulmonary arteries* and *pulmonary veins*? (½ mark)

(iv) What is *systolic blood pressure* and *diastolic blood pressure*? (2 × ½ mark)

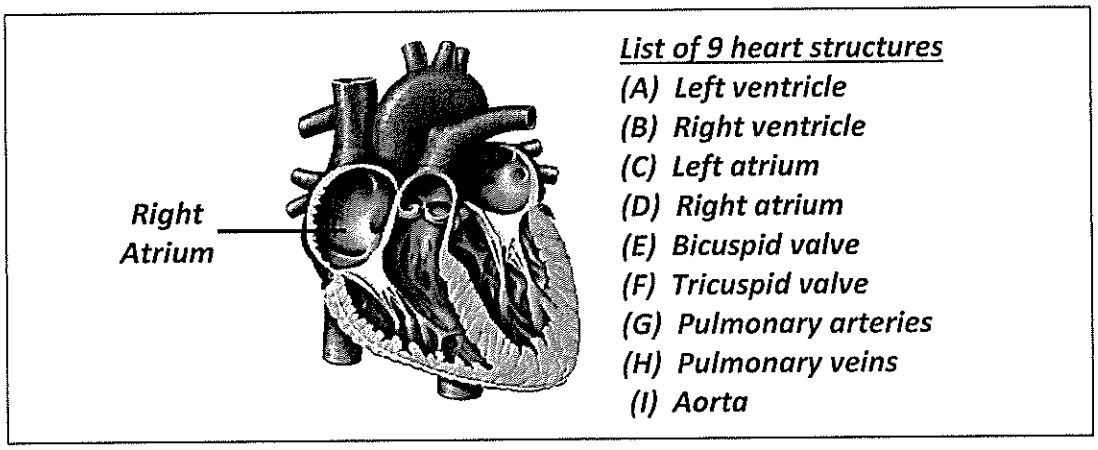

Figure 4

b. *Lymphatic organs* play a vital role in the body's immunity. *Lymphatic organs* include *red bone marrow*, *thymus gland*, *lymph node* and *spleen*. Explain the function of each of these FOUR *lymphatic organs*. (4 × ½ mark)

c. The *antidiuretic* hormone called *vasopressin* determines whether urine will be concentrated or diluted by controlling the amount of water that is reabsorbed from the *nephron* into the bloodstream. Based on this, answer the following:

(i) What is a *nephron*? (½ mark)

(ii) What is the function of a *nephron*? (½ mark)

(iii) What are the THREE main sections in a *nephron tubule*? (½ mark)

(iv) Which of these three main sections of the *nephron* (as answered above) is responsible for increasing the solute concentration in the filtrate? (½ mark)

(v) How does *vasopressin* (an antidiuretic hormone or ADH) affect the concentration of urine (make it more concentrated or more diluted)? Explain. (1 mark)

(vi) The last step of the three distinct processes in urine production is "urine formation". What are the ions involved during "urine formation". (1 mark)

Continued...

Question 5 [10 marks]

a. **Figure 5** below depicts a single *neuron* with all its three major components shown. With this diagram as a reference and guide, answer the following:

(i) Besides *axon*, what are TWO other major components of a *neuron*? (½ mark)

(ii) How does the structure resembling a "chain of beads" help in the transmission of signals along the long axonal strand of the *neuron*? Explain. (2 × ½ mark)

(iii) What happens to a signal that has traveled to the end of this *neuron*? (½ mark)

(iv) Explain the ionic basis of an *action potential* when (A) *Depolarization begins* and when (B) *Depolarization ends and repolarization begins*. (4 × ½ mark)

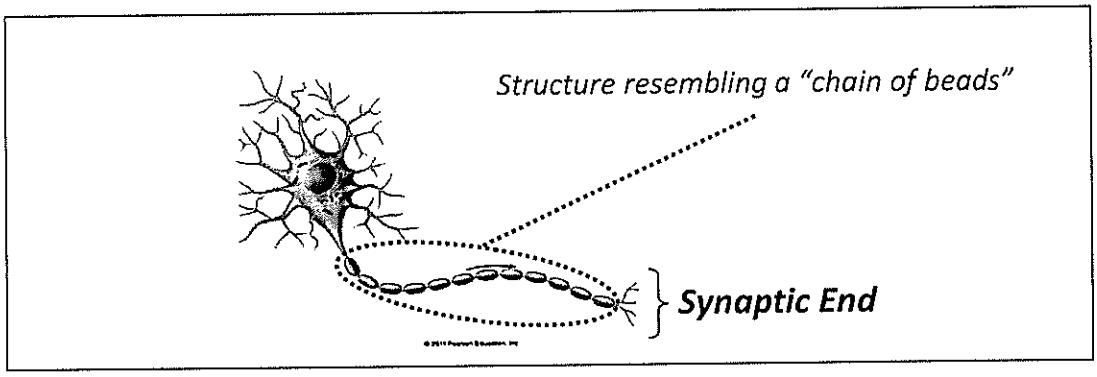

Figure 5

b. **Figure 6** depicts *organ A* and *organ B*, both of which are involved in maintaining normal blood glucose levels in the body. Based on this, answer the following:

(i) What is *organ A* and *organ B*? (½ mark)

(ii) Explain how *organ A* and *organ B* maintain normal blood glucose levels when there is either an increase or a decrease in blood glucose levels. Provide TWO relevant *hormones* (produced by *organ B*) in your explanation. (7 × ½ mark)

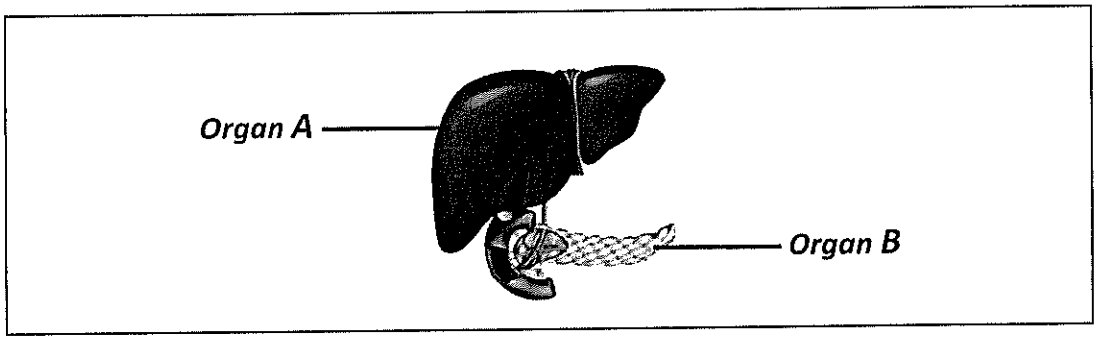

Figure 6

c. A farmer has access to four plant hormones, namely *auxin*, *gibberellins*, *cytokinins* and *ethylene*. In what way could the farmer use each of these four plant hormones in his production of various types of crops? Explain briefly. (4 × ½ mark)

End of paper